U.S. Bureau of Apprenticeship...

National apprenticeship and training standards...

Washington, D.C.

1945

[National joint apprenticeship and training committee for the electrical industry]

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NATIONAL APPRENTICESHIP AND TRAINING STANDARDS

FOR THE

ELECTRICAL INDUSTRY

WAR MANPOWER COMMISSION

BUREAU OF TRAINING

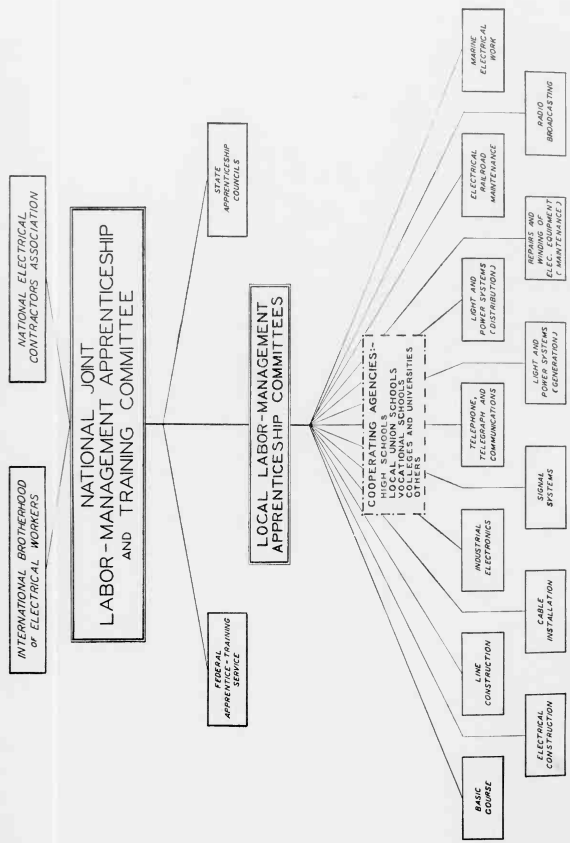
APPRENTICE-TRAINING SERVICE

Washington, D. C.

1945

APPRENTICESHIP
THE KEY TO
ALL-ROUND SKILLS

APPRENTICESHIP SYSTEM OF THE ELECTRICAL INDUSTRY



FOREWORD

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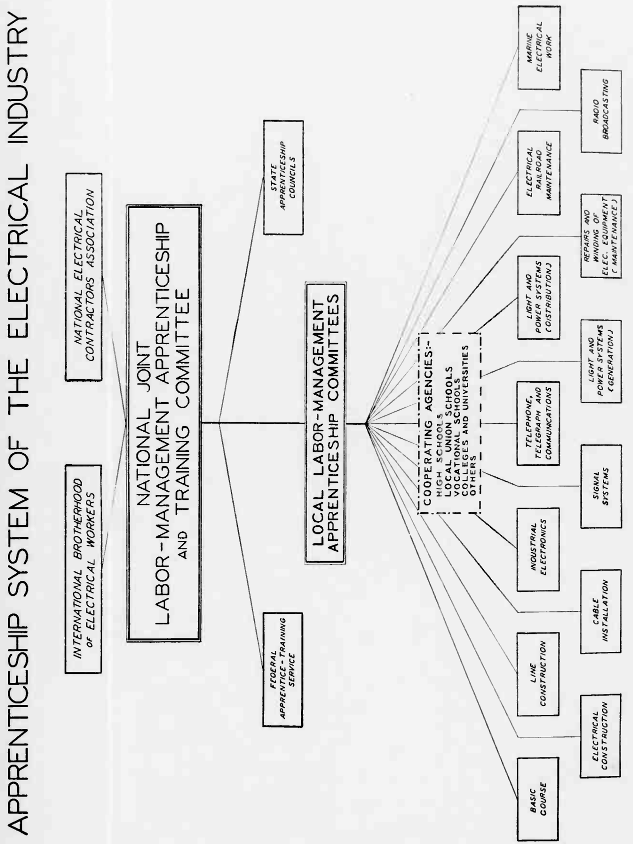
As an indication of the swift and fundamental changes that are now taking place in the electrical industry, it appeared essential that the National Joint Apprenticeship Committee for the Electrical Construction Industry revise these standards, broadening their scope and intensifying their appeal. The new standards do not represent so much basic changes in content and substance as new applications to every branch of the electrical industry.

The standards of August, 1941, contain the following foreword:

"In harmony with the general policy of cooperation which prevails in the electrical construction industry, these National Apprenticeship Standards are the product of the action of a National Joint Committee drawn from union and employer representatives. Consultation with government representatives has been frequent. These standards are the outgrowth of long years of experience in the field. They utilize also the best of the standards accumulated in local districts, where more than 50 joint committees have been at work. Those standards are projected against a background of the electrical industry and the electrical trade, and they seek to correlate the customs and traditions of the industry and the trade which condition apprenticeship standards.

"These National Apprenticeship Standards are guides for the use of local unions and local contractor associations. It is expected that they will not only serve to guide, but will also stimulate formation of local joint committees in order that a nation-wide apprenticeship system will rapidly materialize. The aim, of course, is to produce thousands of electrical apprentices destined to become uniformly competent journeymen craftsmen. These standards should likewise create pride in the electrical industry and the electrical craft."

In planning and developing the national training program in the electrical industry, the committee gratefully acknowledges the valuable assistance of William F. Patterson, Director, Apprentice-Training Service and Assistant Directors of this agency, Ansel R. Cleary and Maurice M. Hanson, who is also National Consultant for the Construction Industry.



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NATIONAL JOINT APPRENTICESHIP AND TRAINING COMMITTEE FOR THE ELECTRICAL INDUSTRY

Representing the National Electrical Contractors' Association	Representing the International Brotherhood of Electrical Workers
E. H. Herzberg (*Chairman*)	Ed. J. Brown (*Vice-Chairman*)
Robert W. McChesney	M. H. Hedges (*Secretary*)
E. C. Carlson	G. M. Bugniazet
J. W. Collins	H. W. Maher
W. F. McCarter	C. W. Spain
P. M. Geary	William D. Walker

CONTENTS

NATIONAL APPRENTICESHIP AND TRAINING STANDARDS FOR THE ELECTRICAL INDUSTRY

I. BASIC SKILL

Change and Stability.—Change is a manifestation of all industries. Changes are more fundamental and more swift in the electrical industry. Change in the electrical industry is dictated by the rapidly expanding character of electrical science. Indeed some authorities take the position that new devices in technology originate usually in the electrical industry and then are introduced into other industries, bringing about the same fundamental changes in methods and direction.

The global war certainly furnished a laboratory for the rapid introduction of new technological devices. Trends that had been present in the electrical industry for 25 years suddenly plowed deep into actuality. Before the global war the electronic branch of the electrical industry was doing a business of about one billion dollars a year. During the four years of the war, the electronic industry quadrupled its output of electronic machines and is now doing a business of about four billion dollars a year. The settled expectations of industrial leaders in the electronic industry are that the electronic branch of the industry will probably absorb about 25 per cent of the capital, the production and distribution of the entire electrical industry. The electrical construction branch of the industry, where apprenticeship training had its origination and its strongest hold and where recruiting for the entire electrical industry occurred, felt actively the same sweeping changes that other sections of the electrical industry felt. Moreover, it became apparent that the traditional boundary lines between segments of the electrical industry were not and could not be preserved in their traditional sense; the electrical industry tended to unification.

It became apparent, therefore, to the National Joint Apprenticeship and Training Committee that the standards issued in August, 1941, should be reexamined and extended to meet the changing character of the electrical industry.

While these changes were apparent, it was also clear that skill had not lessened but was enhanced during the period of the global war. Skill, whether it be the skill of the mechanic or of the technician or engineer, is the stabilizing factor in the industry. National standards merely emphasize this basic fact. It is clear also that skill is not vested interest of any one segment of the electrical industry nor can it be anchored to any geographical locality. Skill

is basic. Standards that seek to evaluate this skill must be national standards. Skill first rests upon the technical knowledge of electrical science. This knowledge until it is applied by the mechanic, the technician and the engineer is so much deadwood. Knowledge applied makes skill.

The art of handling electricity is regarded as being all one piece; that is fundamentals are uniform and are basic to all branches of the electrical industry. In view of the fact that the electrical industry is organized on what has come to be called a horizontal basis; in view of the fact that the electrical industry is national and tends to standardize its products, however varied, on any basis other than geographical, standards of apprenticeship may be and should be uniform not only in all branches but in every geographical location.

It appears that much progress can be made if and when local joint apprenticeship committees work in close conjunction with the National Joint Apprenticeship and Training Committee.

All local or area joint apprenticeship and training committees will be contacted from time to time by the national joint committee for facts and figures on the status of apprenticeship and training in their area.

It is also apparent that apprentices and journeymen ought to be prepared to supplement their regular training with night school courses at their own expense, time and money. This is the only way in which the craftsman can master the vast amount of learning necessary to make him a first-class mechanic.

II. CHARACTER OF THE ELECTRICAL TRADE

Simplicity and Complexity.—Skill is basic. Skill rests upon a knowledge of electrical science and the mastery of the expanding frontiers of electrical science. The apprentice, therefore, must receive first of all basic training in the theory and fundamentals of electricity and craftsmanship and may pass to specialized training in any one of the important branches of electrical science and the electrical trade. For the purpose of these standards the following segments of the industry are recognized:

Electrical construction
Line construction
Cable installation
Industrial electronics
Signal systems
Telephone, telegraph and communications
Light and power systems (generation)
Light and power systems (distribution)
Repairs and winding of electrical equipment (electrical maintenance)
Electrical railroad maintenance
Radio broadcasting
Marine electrical work
Rigging*
Welding*

Basic training will have principally to do with the theories and

* Segments of the craft performed in every branch of the trade.

fundamentals of electrical science; fundamentals of mathematics; mastery of electrical circuits and diagrams; electrical and mechanical drawings; laboratory testing.

III. ELEMENTS IN THE MASTERY OF SKILL

Road to Skill.—The electrical trade, unlike some trades, is mechanical, technical, and professional. It must draw men who have a natural aptitude in using tools and it must at the same time attract men who are gifted enough to master the intricacies of electrical science. Training must be given in the intelligent selecting and handling of measuring rules and scales; saws, drills, and taps for various purposes and metals; ropes and blocks; and a practical knowledge of the application of levers, gears, and pulleys, along with the ability to rig efficiently for hoisting and erecting equipment and materials. Moreover, mathematics, as in most crafts and professions, is basic to full mastery. Too frequently, the electrical trade is regarded merely as a mechanical art, whereas it is a combination of the mechanical, technical, and professional, for it shades in at the top to the work of the electrical engineer.

The men are classified as electricians and supervising electricians. The supervising electrician is a registered electrician, and he is qualified to interpret electrical rules contained in the national and local electrical codes governing the safe and proper installation of electrical equipment. The scope of his work requires him to have some knowledge of electrical engineering. Indeed, organization of the electrical industry is based upon the character of the electrical trade; that is, with electrical mechanics at the base, mechanics professional or supervising electricians within the journeymen ranks, and with electrical engineers or technicians as contractors.

Because the proper handling of electricity is regarded by city councils, legislatures, and courts as touched with public significance, there is a clear relationship between the electrical trade, the art of installation, and the public welfare. The continuous operation of electrical equipment, the prevention of fires, and the protection of human life are regarded as functions of electrical workers whether they be electrical mechanics, mechanics professional, supervising electricians, or contractors. Electrical science is constantly changing and expanding. This, in turn, conditions the electrical arts. The electrical industry has moved from nothing to the third largest industry in one generation. This means that sound basic training must be given early to the apprentices; that this must be supplemented by a certain amount of theoretical instruction in electricity; and that some provision must be made for training and retraining in an expanding science. Post-graduate courses are desirable that journeymen may keep pace with this changing science. As viewed

by the electrical industry, general training should and does precede specialization on the part of the apprentices or the journeymen. The standard here involved is not unlike that obtaining in the academic world where a liberal-arts education must precede specialization in the professions. Moreover, it is generally conceded that training of mechanics must be done upon the job and all arts must be learned by doing. Only a minor part of the time of learning the electrical trade is spent in technical classes.

The electrical trade presents evidence of a high degree of responsibility on the part of trained craftsmen. Some of these are:

(1) Every job presents variations and individual problems which demand decision by the journeyman for their practical and successful solution. Generally an electrical craftsman works there and must take responsibility for the particular segment of the job.

(2) Journeymen on many jobs have opportunity of dealing with customers. The personal conduct of the craftsman conditions future advancement of the trade and industry.

(3) A workmanly job is inclusive of the aesthetic. Slovenly work with no regard for the neat and sightly is generally poor work, from the craft point of view. Shapely work is generally sound and safe work.

(4) The mechanic has responsibility for the interconnection and construction of a complex electrical system. Adequate performance of his task is necessary to make this system work adequately. Generally speaking, in the electrical industry, mechanics, professional and supervising electricians operate under the supervision of city and state inspectors, which demands and assures a high standard of workmanship.

(5) All craftsmen must have a working knowledge of municipal, state and national electrical codes and the codes of practice within the industry.

IV. MACHINERY OF TRAINING

Machinery of Education.—The machinery of apprenticeship already in widespread use is conditioned by the scope and character of the electrical industry and the nature of the electrical trade.

Because of the trade's approach to the professional level, experience has proven that a combination of practical and theoretical instruction must be provided apprentices. Experience has also shown that a planned system of apprenticeship which will cover every apprentice employed in the electrical trade in a community must be set up. This system is developed by a joint committee of equal representation from the electrical contractors and from the electrical workers. It contains the standards governing the employment and training of electrical apprentices and the method

through which the system is to be administered. The apprenticeship system is then approved by the interested organizations and is placed in operation.

For many years a number of highly successful apprenticeship systems built on those lines have been in operation. All, whether set down in writing or not, follow a consistent pattern.

In recent years great stimulus has been given to the setting up of apprenticeship systems in all trades by the Apprentice-Training Service,* War Manpower Commission, and its policy-making Federal Committee on Apprenticeship. The national organizations of electrical contractors and electrical workers have encouraged local affiliated organizations to cooperate with the Federal Committee, and from the experience of such local groups these national standards have been built.

V. STANDARDS

Definition of Electrical Apprentice.—The term apprentice as used shall mean a person at least 18 years of age who preferably has a high school education or its equivalent, who is covered by a written agreement with the local joint apprenticeship committee, recognized by the Federal Committee on Apprenticeship, and by an approved supplementary agreement with an employer, providing for not less than 8,000 hours of reasonably continuous employment for such person, and for his participation in an approved schedule of work experience through employment, supplemented by at least 144 hours per year of related classroom instruction.

Terms of Apprenticeship Instruction.—It shall be regarded that 8,000 hours of work and class-room experience will give the equivalent of 5 years' training, and it shall be recommended that it take 5 years of training to produce a well-rounded journeyman.

Probationary Period.—All apprentices employed in accordance with these standards shall be given a probationary period not exceeding 6 months. During this probationary period annulment of the apprentice agreement may be made by the local joint apprenticeship committee on request of either party without the formality of a hearing.

After the probationary period the agreement may be cancelled by the joint apprenticeship committee for good cause. The Committee shall notify the registration agency of all terminations of agreements and the reasons therefor.

Qualifications for Apprenticeship Applicants.—Candidates for electrical apprenticeship not hitherto connected with the trade

* Originally established in the U. S. Department of Labor; transferred April 18, 1942, by Executive Order No. 9193 to the Federal Security Agency; and on September 17, 1942, transferred by Executive Order No. 9247 to the War Manpower Commission.

must be between the ages of 18 and 24 years. The following information shall be submitted to the local joint apprenticeship committee by each apprentice applicant:

(*a*) Birth certificate or military discharge.

(*b*) Transcript of school courses and grades.

(*c*) Record of physical examination.

(*d*) Exception to the above age limit should be made in cases of discharged veterans. In such cases the age of the veteran should be considered as of the time he entered military service.

"Post Graduate" Training.—It is strongly recommended that provision be made under the guidance of the local joint apprenticeship committee for keeping abreast of the expanding electrical science. The educational process for the apprentice should be viewed as continuous not only through his formal training but after he becomes an accepted journeyman. In some cases this is done through post-graduate societies which give short courses in special subjects as they appear in the field.

Apprentice Wages.—Apprentices shall be employed on a stipulated wage basis. The first year's wage should be fixed by contract but not less than 25 percent of the journeyman's wage. Toward the second half of the second year the apprentice should move into the category of the actual wage earner. Wages in the third and fourth years should be high, and the wage for the whole period should average at least 50 percent of the journeyman's wage.

The Ratio of Apprentices to Journeymen.—The ratio of apprentices to journeymen varies, but should be determined by collective bargaining.

Trained Instructors.—All related classes for apprentices should be conducted by trained instructors, cognizant of good educational technique as well as thoroughly grounded in mechanics and electrical science.

Periodical Examination.—Examination of apprentices shall be given before each period of advancement and at such time as determined by the local joint apprenticeship committee.

*Apprenticeship Agreement.**—The apprentice shall be required to sign an agreement or contract with the local joint apprenticeship committee. If the apprentice is a minor the legal guardian shall also sign the agreement. A supplementary contract shall be signed as between the employer to whom the apprentice is assigned and the local joint apprenticeship committee.

Identification of Apprentices.—Each apprentice, after signing his contract, shall be furnished with an identification card signed by the secretary of the local joint apprenticeship committee. The card shall show the apprentice's name, address, date of birth, the date of the beginning of the apprenticeship, the name of the employer to whom the apprentice is assigned, the record of the apprentice's school attendance, and the signature of the apprentice.

Composition of Joint Electrical Apprenticeship Committees.—The local joint apprenticeship committee shall be composed equally of three or more members representing employers and three or more members representing employees. Members of the apprenticeship committee shall be selected by the groups they represent. The term of office shall be 3 years, the term of one employer and one journeyman to expire each year with vacancies to be filled in the same manner as the original appointment was made. The committee shall select from its members a chairman and a secretary who retain voting privileges. The committee shall meet once a month or on call of the chairman.

"Consultants such as those from the Apprentice-Training Service, the vocational schools and engineers from corporations may be requested to sit with the joint committees, but only in an advisory capacity."

Duties of the Local Joint Apprenticeship Committee.—

(*a*) To determine the need for apprentices in the locality, and shop facilities available for the necessary experience on the job.

(*b*) To establish minimum standards of education and experience required of apprentices.

(*c*) To determine the adequacy of an employer to give training.

(*d*) To see that apprentices are under agreement. Where it is impossible for one employer to provide the diversity of experience necessary to give the apprentice all-round instruction in the branches of the trade, or where the employer's business is of such character as not to provide continuous employment over the entire period of apprenticeship, the committee shall transfer the apprentice to another employer, and the supplementary employer's agreement shall be likewise transferred. This agreement does not obligate the committee actually to employ the apprentice, but it stipulates that it shall use its best endeavors to keep the apprentice continuously employed and adequately instructed.

(*e*) To determine the quality and quantity of experience on the job which the apprentice must have, and to be responsible for his obtaining it.

(*f*) To hear and adjust all complaints of violation of apprentice agreements.

(*g*) To arrange tests for determining the apprentice's progress in manipulative skill and technical knowledge.

* Apprenticeship agreement forms may be obtained from the National Joint Apprenticeship and Training Committee for the Electrical Industry or from the National Electrical Contractors Association or International Brotherhood of Electrical Workers.

(*b*) To maintain a record of each apprentice, showing his education, experience, and progress in learning the trade.

(*i*) To recommend when the apprentice is sufficiently prepared to be eligible for taking the journeyman electrician's examination.

(*j*) To make an annual report covering the work of the committee to the respective employer and employee groups.

(*k*) To be responsible in general for the successful operation of the apprenticeship standards of the electrical trade in the given community: by performing the duties listed above; by cooperating with public and private agencies which can be of assistance; by obtaining publicity, in order to develop the support and interest of the public in the apprenticeship standards; by keeping in constant touch with all parties concerned—apprentices, employers, and journeymen.

(*l*) To request the appropriate State Apprenticeship agency, recognized by the Federal Committee on Apprenticeship, to register each apprenticeship agreement, which automatically registers such agreement with the Federal Apprentice-Training Service. If no such State agency exists the request should be made of the Federal Committee on Apprenticeship, Apprentice-Training Service, WMC, Washington 25, D. C., bearing in mind that the Federal Committee on Apprenticeship is a policy-making body for voluntary apprenticeship.

(*m*) To notify the appropriate registration agency of all terminations or cancellations of apprenticeship agreements.

(*n*) To recommend that each apprentice be issued a certificate of completion after the apprentice has completed the examination by the local joint apprenticeship committee.

(*o*) All joint apprenticeship committees shall send their standards to the National Joint Apprenticeship and Training Committee for review before final approval by the contractors and the electrical workers in order to assure that the local standards are in conformity with the National Standards and to obtain the benefit of the apprenticeship experience in our industry throughout the country.

All joint apprenticeship committees shall send a copy of their standards to the national joint apprenticeship committee after final approval by the contractors and the electrical workers.

All joint apprenticeship and training committees should send periodical reports to the national joint committee on the number of apprenticeship agreements that are registered, completed, and cancelled.

Rotation of Employment.—It shall be the duty and responsibility of the local joint committee to provide, insofar as possible, continuous employment to all apprentices. This may necessitate the transfer of apprentices from one employer to another.

Hours of Work for Apprentices.—Hours of work shall be governed by agreement and should conform to schedule set up for journeymen. Under stipulated conditions, apprentices may be permitted to work overtime.

Adjusting Differences.—In case of dissatisfaction between the employer and the apprentice, either party has the right and privilege of appealing to the local joint apprenticeship committee for such action and adjustment of such matters as come within these standards.

Compliance with Apprenticeship Standards.—Every apprentice shall be given the opportunity to read the standards under which he is employed. The local standards shall be made a part of the apprenticeship agreement.

Panels of Candidates for Apprenticeship.—It is strongly recommended that panels of apprentices or candidates for apprenticeship be set up by the local joint apprenticeship committee and that the local joint apprenticeship committee shall have the right of selecting of apprentices from these panels. All agreements signed by electrical contractors and electrical employees shall provide for local apprenticeship training in terms of these National Apprenticeship and Training Standards for the Electrical Industry.

It is recommended that local joint apprenticeship committees take into account work applicable to the electrical trade which veteran applicants have performed while in the armed forces and give appropriate credit for such work on the term of apprenticeship.

VI. BASIC RELATED INSTRUCTION

The following material is presented as a recommended outline of basic training in the theory of electricity for the union apprentice. It is intended as minimum or basic rather than maximum in scope.

Apprentice training should always be considered the training of an individual, planned to meet his needs and develop his potentialities toward the desired objective of a skilled mechanic.

THEORY

To develop as electrical background by which an apprentice will understand the "why" as well as the "how" of things pertaining to his trade; to make possible, through a basic knowledge of fundamentals, the solution of new problems as they arise in the future; and to enable him to profit by reading or studying throughout his electrical career.

Any modern one-volume general textbook outlines the basic information needed by the apprentice.

The apprentice student must at least learn enough theory to accomplish intelligently the work of his other courses and in so

doing should acquire an electrical vocabulary, a knowledge of the relationship between the various units of measurement, the solution of given formulae, the methods of creating current electricity, relative conductors and insulators, comparative effects and uses of A.C and D.C., magnetism, electro-magnetism, electro-magnetic induction, internal construction of dynamos, sources of information which need not be memorized, etc.

Any necessary review or teaching of mathematics to be given as needed.

ELEMENTARY THEORY OF ELECTRICITY

Direct Current

1. Units, Ohm's Law and Resistance Measurements.
2. Magnetism and Electro Magnets.
3. Electric Power Relations.
4. Electric Power and Work.
5. Electric Power and Heat.
6. Wire Gauge; Resistance of Wire as Related to Size, Length, and Kind of Metal; Effects of Heat on Resistance of Conductors and Insulations.
7. Review Questions*.
8. Electric Generator.
9. Shunt Generator and Characteristics.
10. Compound Generator and Characteristics.
11. Review Questions*.
12. Electric Motors.
13. Shunt Motor and Characteristics.
14. Series Motor and Characteristics.
15. Compound Motor and Characteristics.
16. Effects of Armature Reaction and Interpoles.
17. Review Questions*.
18. Manual Starters and Speed Control for Direct Current Motors.
    a. Starting Boxes.
    b. Drum Controller.
    c. Reversing Controllers.
19. Dynamic and Regenerative Braking.
20. Common Electrical Troubles and Remedies in Direct Current Generators.
21. Common Electrical Troubles and Remedies in Direct Current Motors.
22. Common Mechanical Troubles in Direct Current Machines.
23. Review Questions*.
24. Armature Windings of Direct Current Machines Lap Windings.

* Requiring outside reading to answer.

25. Armature Windings of Direct Current Machines Wave Windings.
26. Testing Direct Current Motors:
    A. Insulation Resistance.
    B. Armature Windings.
    C. Field Windings.
    D. Grounds.
    E. Torque and Horsepower.
    F. Load Tests.
27. Adapting Direct Current Machines to Changed Conditions.
28. Review Questions*.
29. Standard Ratings and Types of Direct Current Machines.
30. Construction and Operation of Electric Measuring Instruments; Shunts and Multipliers.
31. Review Questions*.

Alternating Current

32. Single Phase Alternator:
    Effective Voltage.
33. Three Phase Alternators.
34. Voltage and Current Relations in Three Phase Circuits.
35. Impedance and Resistance.
36. Inductive Reactance.
37. Capacity Reactance.
38. Review Questions*.
39. Impedance Circuit with Resistance Inductive Reactance and Capacity Reactance.
40. Phase Relation between Voltage and Current in a circuit having only Resistance. Power in single phase circuit. Power Factor.
41. Phase Relation between Voltage and Current in a Circuit Containing only Capacity Reactance. Power Factor.
42. Phase Relation between Voltage and Current in a Circuit Containing only Inductive Reactance. Power Factor.
43. Phase Relation between Voltage and Current in a Circuit Containing Resistance and Induction Reactance. Power Factor.
44. Phase Relation between Voltage and Current in a Circuit Containing Resistance, Inductive, and Capacity Reactance. Power Factor.
45. Review Questions*.
46. Electric Power in a Single Phase; In a Three Phase Circuit.
47. Single Phase Transformers.

(*) Requiring outside reading to answer.

48. Two Phase Transformers.
49. Three Phase Transformers.
50. Phase Transformation.
51. Review Questions*.
52. Three Phase Squirrel Cage Motors.
53. Polyphase Motor Starters:
    Manual Control.
54. Polyphase Motor Starters:
    Magnetic and Remote Control.
55. Review Questions*.
56. Three Phase Slip Ring Motors:
    Manual Control.
57. Three Phase Slip Ring Motors:
    Magnetic and Remote Control.
58. Three Phase Motor Overload Protection.
59. Review Questions*.
60. Universal Motor.
61. Single Phase Split Phase Motors.
62. Single Phase Repulsion Induction Motors:
    Brush Lifting.
63. Single Phase Repulsion Induction Motors:
    Brush Riding.
64. Single Phase Capacitor Motors.
65. Review Questions*.
66. Standard Ratings and Types of Alternating:
    Current Motors.
67. Three Phase Power.
68. Three Phase Synchronous Motors.
69. Review Questions*.
70. Three Phase Stator Windings.
71. Three Phase Rotor Windings.
72. Common Electric Troubles and Remedies in Three Phase Squirrel Cage Motors.
73. Common Electric Troubles and Remedies in Slip Ring Motors.
74. Common Electric Troubles and Remedies in Synchronous Motors.
75. Common Mechanical Electric Troubles and Remedies in Single Phase Motors.
76. Review Questions*.
77. Two and Four Speed Induction Motors.
78. Adapting Alternating Current Machines to Changed Conditions.
79. Testing Alternating Motor Windings for:
    a. Insulation Resistance.

* Requiring outside reading to answer.

    b. Opens, Shorts.
    c. Winding Connections.
    d. Torque and Horsepower.
    e. Load Tests.
80. Review Questions*.
81. Alternating Current Measuring Instruments, Current Transformers and Potential Transformers.
82. Alternating Current Switchboards.
83. Review Questions*.
84. Voltage Regulators:
    a. Alternate.
    b. Line.

LABORATORY TESTING

Further to develop his theoretical knowledge by applying and checking it under practical conditions.

Suggested Content

Applied Theory.

(*Not listed as separate experiments, nor in sequence.*)

Use of measuring instruments.
Measurement of resistance by all methods.
Methods of power measurement.
Computation of costs of operating lighting loads.
Application of laws of series and parallel circuits.
Primary and secondary cells.
Effects of line drop.
Checking instruments by comparison for accuracy.
Circuit tracing: Receiver, lamp, bell, instruments.
Megger and magneto testing.
Effects of Magnetism and electro-magnetism.
Electro-magnetically induced currents.

Motors and generators, all types and their auxiliary equipment; connection, operation, reversal, testing, paralleling, speed measurement, speed regulation, diagnosis of trouble.

Protective equipment.

Comparison of effect on circuits containing only one and combinations of (a) Resistance, (b) Inductance, (c) Capacitance.

Text for power factor.

ELECTRICAL DRAWING

To develop an ability to interpret diagrams, sketches, and drawings.

* Requiring outside reading to answer.

Suggested Content

Use of T-square, triangles, and drawing instruments.
Use of rule to measure distances by scale.
Electrical symbols and standards practices.
Circuit diagrams.
Wiring diagrams of equipment.
Freehand Sketching of simple objects:
(a) Orthographic projection.
(b) Isometric projection.
(c) Dimensioning.
Drawing a simple floor plan with electrical lay-out.
Tests on reading of commercial blueprints of actual jobs by answering prepared questions concerning the prints.

DRAWINGS, DIAGRAM OF ELECTRICAL CIRCUITS

1. Dry Cell Connections.
2. Electric Symbols.
3. Bell Circuits.
4. Annunciator Circuits.
5. House Telephones.
6. Electric Light Circuits.
7. Direct Current Motor Circuits.
8. Direct Current Generators.
9. Armature Windings.
10. Direct Current Meters and Instruments.
11. Switchboards.
12. Manual Controls, Crane or Hoist, Speed Above and Below Normal, Printing Press.
13. Automatic and Remote Control.
14. Transformer Connections One, two and three phase.
15. Single Phase Motors, Split Phase Repulsion Induction, Capacitor, Variable Speed, Capacitor Motor, Universal Motor, Variable Speed Brush Shifting.
16. Three Phase Squirrel Cage Induction Motors with Manual Starters.
17. Three Phase Squirrel Cage Induction Motors with Automatic and Remote Control.
18. Three Phase Slip Ring Induction Motors with Manual Control.
19. Three Phase Slip Ring Induction Motors with Automatic & Remote Control.
20. Alternating Current Meters and Instruments.
21. Synchronous Motors with Manual Control, Semi-Automatic and Automatic Control.
22. Alternating Current Switchboards.
23. Electronic Control Circuits.

Free hand drawings, using faint line cross-ruled paper.

Proper Use and Care of Tools.—Demonstration and practice in the proper technique of using hand and power tools with personal safety, and with regard to the cost and life of equipment. Distributors often are glad to demonstrate newly developed tools.

Hand Tools and Processes.—Drilling and tapping, bolt threading, making typical brackets and hangers, light welding and cutting, folding a box, laying out and cutting holes for conduit with various types of hold cutters and reamers, chipping and filing, sharpening of drills and chisels, bending and flattening heated wrought iron, screw threads, screw gauges, use of micrometer and caliper, etc.

RELATED METAL WORK

To acquaint the apprentice with metal working tools and machinery which he may be called upon to use in the electrical field.

Rope Work.—Confine to tying and splicing used in electrical rigging and cable pulling. Tying: Square (reef) bowline, clove hitch, girth hitch, barrel hitch, half hitch, single and double bend, bowline-on-a-bight. Splicing: Eye-splice, back-splice, short-splice.

OPERATION, MAINTENANCE, AND REPAIRS

The finished electrician is called upon to operate, maintain, and repair the complete electrical industry. He should continue his study of the industry to keep abreast of the times and should seek information on the following items:

Suggested Topics

Photo-electric cells.
Automatic elevators and their controls.
Large synchronous and wound rotor high-voltage motors.
Motors and their associated controls for air conditioning.
High-tension transformers.
Network systems.
Network projectors.
A.C. and D.C. armature winding.
Resistance or induction methods of pre-heating and stress relieving.
Rewinding coils, compensators, and transformers.
A.C. generators.
Motor generators, rotary and synchronous converters.
Electrically operated ventilating equipment.
Signal systems, such as:

Intercommunicating telephone systems and dictographs.
Public-address systems, sprinkler alarm systems.
Night watchman report systems.
Photographic machines, arc and mercury lamps.
Operation and maintenance of modern projection machines and their complex sound equipment.
Impulse-type clock systems.
Storage batteries and charging equipment.
Laboratory units which call for electrical service in connection with their experiments involving pyrometer control.
Precipitators operating at 75,000 volts.
Cranes and skip hoists.
Coal and ash handling equipment.
Smoke detectors.
Electrical instruments and their various applications.
Operation of switchboards in paralleling generators.
High-voltage oil switches.
X-Ray machines.
Electrically operated refrigeration for water coolers.
Knowledge of automatic controls.
Direct current machinery and circuits.
Alternating current machinery and circuits.
Metering equipment—A.C. and D.C.

TRADE TECHNOLOGY

To tie together and condense all the training and experience into practical application; to provide technique and "tricks of the trade," and to provide discussion of recent developments and current problems.

Suggested Topics

First Aid.
Artificial respiration—on ground or elevated.
Safety methods.
The National Electrical Code as it applies to grounding, sizes of conductors, conduits, fuses, switches, cut-outs, panelboards, etc., permissible materials in prescribed locations, definitions of terms used, interpretation and use of tables.
Organization of code and how to find desired information, etc.
How inspection departments function.
The local utility company's plan of distribution, voltages and phase-systems supplied, and their service requirements.
Sub-station planning and construction.
Handling of heavy equipment.
Transformer connections.
Vector diagrams and cross-phase voltages.

Maintenance of equipment.
Stress welding relief.

VOCATIONAL CIVICS AND ENGLISH

To combine the twofold purpose of improving the apprentice's use of the English language while acquiring a knowledge of the non-technical things which affect or concern the life of the union electrical worker.

Conference method should be used.

Suggested Topics

Oral Discussion.—The moral responsibility of an apprentice to the public to his local union, and to his employer.

Brief history of the labor movement. Advantages versus disadvantages of organized labor to (a) worker, (b) employer.
Parliamentary procedure.
The constitution of the union.
Trade union ethics.
Proper method of obtaining employment.
Read and discuss sample specifications.

Written work should include:
Business correspondence.
The writing of minutes.
The writing of a resolution.
A report of job progress.
Description of equipment.
Form of writing an estimate or bill.
Building construction reading.
Welding and brazing.

VII. CONTENT OF TRAINING FOR ELECTRICAL CONSTRUCTION

Training should always be considered the training of an individual, planned to meet his needs and develop his potentialities toward the desired objective of a skilled mechanic.

Electrical construction work consists of four major elements, namely: Residential, commercial, industrial and specialized, each of which involves part of the following:

Signal Wiring.—Simple call-bell, return-call, burglar-alarm, fire-alarm, elevator, apartment house, inter-communicating phones, and nurse-call circuits using all types of push buttons and equipment such as relays, drops, annunciators, etc.

Lighting.—Fundamental lighting circuits, based upon the different kinds of switch control, should first be taught with open work and then repeated and varied with a sufficient number of jobs

on each "Wiring Method" (as listed in the chapter of that name in the National Electrical Code) to familiarize with the fittings and working of that material method.

Fixture Work.—Appropriate assembling, wiring, and hanging of fixtures to be included with the wiring.

Joining of Wires.—To include, at the appropriate stage of the course, the making of splices and taps and the use of various types of connectors.

Wiring for Power.—Arrangement of conduit, fittings, boxes, etc., for the connection of equipment such as starters, compensators remote-control buttons, etc. Heavy equipment to be set in place by students. (Preferable, but not essential.) Permanent mounting of a few sets suggested.

Rope Work.—Confine to tying and splicing used in electrical rigging and cable pulling. Tying: Square (reef) bowline, clove hitch, girth hitch, barrel hitch, half hitch, single and double bend, bowline-on-a-bight. Splicing: Eye-splice, back-splice, short-splice

Proper Use and Care of Tools.—Demonstration and practice in the proper technique of using hand and power tools with personal safety, and with regard to the cost and life of equipment. Distributors often are glad to demonstrate newly developed tools.

Appliance Repair.—Diagnosis and repair of trouble on common appliances supplied by student or teacher. (To include commutator cleaning and turning.)

RELATED METAL WORK

To acquaint the apprentice with metal working tools and machinery which he may be called upon to use in the electrical field.

Power Machines.—Use of engine lathe, drill press, grinder, electric drill, power hacksaw, bending machines, and threading machines, electric cranes and welding machines.

Hand Tools and Processes.—Drilling and tapping, bolt threading, making typical brackets and hangers, light welding and cutting, folding a box, laying out and cutting holes for conduit with various types of hole cutters and reamers, chipping and filing, sharpening of drills and chisels, bending and flattening heated wrought iron, screw threads, screw gauges, use of micrometer and caliper, etc.

VIII. LINE CONSTRUCTION

Training should always be considered the training of an individual, planned to meet his needs and develop his potentialities toward the desired objective of a skilled mechanic.

The complete construction and maintenance of overhead and underground electrical systems for the transmission and distribution of electrical energy for light and power, and communications.

Line work consists of:

1. Erecting and setting posts, poles and towers.
2. Attaching necessary cross-arm, transformers, circuit-breakers, cutouts, lightning arresters, anchors, guys, and messengers wires to such structures.
3. Stringing, sagging, insulating, attaching, and connecting of conductors.
4. Installation of underground conduit systems, including conduit, laterals, vaults, sewer drains, and grounds.
5. Installation of underground cable, transformers, switch boxes, loading coils, and similar equipment.

IX. CABLE CONSTRUCTION

Training should always be considered the training of an individual, planned to meet his needs and develop his potentialities toward the desired objective of a skilled mechanic.

Cable work consists of:

1. Test and trace circuits in power and communication systems.
2. Make various types of connections between electrical conductors, such connections to have adequate mechanical strength and electrical carrying capacity for the electrical currents to be carried thru such connections.
3. Properly insulate conductors for the voltage conditions under which they are to operate.
4. Where necessary, seal cable joints within a waterproof housing such as a lead sleeve wiped onto the lead-sheathed cables entering the joint.
5. Properly to bond and ground lead-sheaths of cables of all voltages.
6. To make electrical connections between conductors and various types of equipment such as transformers, potheads, terminal boxes, and junction boxes; such connections to be waterproof where necessary.
7. Installing maintenance, repair of oil filled cables.
8. Weatherproofing and fireproofing of cables.

X. INDUSTRIAL ELECTRONICS

The following material is presented as a recommended outline of basic training in the theory of electricity for the union apprentice. It is intended as minimum or basic rather than maximum in scope.

Training should always be considered the training of an individual, planned to meet his needs and develop his potentialities

toward the desired objective of a skilled mechanic.

Electronics work consists of:

Phototube Applications

Photoelectric light control.
Photoelectric drinking fountain control.
Photoelectric dumb-waiter control.
Photoelectric door operation control.
Photoelectric waft straightening control.
Photoelectric cut-off in register with imprint in bag making and package wrapping machines.
Photoelectric safeties for conveyors, stopping them when jams occur.
Photoelectric synchronizing of two conveyors.
Photoelectric feeding of can making machines.
Photoelectric weighing, counting and sorting processes.
Photoelectric Machine for grading products to size and color.
Photoelectric sheet catching tables in rolling mills.
Photoelectric kick-off on steel mill run-out tables.
Photoelectric conveyor control in heat treating furnaces.
Photoelectric inspection of products for defects.
Photoelectric alarm equipment visible and invisible.
Photoelectric smoke density indicator.
Photoelectric level control.
Photoelectric indication of paper breaks on paper machines.
Photoelectric race track finish line judging.

Phanotron Applications

Rectifier applications for low power levels.
Adjustable and self-regulating battery charges.
Direct current power supply for magnetic chucks and magnetic separators.

Thyratron Applications

Automatic control systems for regulating the electrical power input to electric annealing furnaces, air heaters, boilers, steam superheaters, chemical reaction chambers and electric ovens.
Synchronous thyratron resistance welder control for spot and projection welders.
Sequence timers for resistance welding.
Thyratron motor control.
Control of heating and air conditioning systems.
Electric furnace temperature control.

Ignitron Applications

Rectifier applications for high power levels.

Contactors for spot or seam welding of aluminum alloy, steel and stainless steel.

Pliotron Applications

Control of heating and air conditioning system.
Grid controlled high vacuum tube amplifier or oscillator.
Induction heating.
Dielectric heating.
Surface hardening.

Kenotron Application

High voltage rectifier.
Precipitron equipment.
Smoke abatement.
Paint spraying processes.
Excess paint removal processes.
Cable testing.
X-Ray equipment.
Abrasive paper coating processes.
Welding.

Cathode-Ray Tube Applications

Iconoscope.
Electron microscope.
Oscilloscopes.

Industrial X-Ray Tube Applications

The one million volt industrial X-Ray equipment for detecting flaws to depth of eight inches in steel castings.

XI. SIGNAL SYSTEMS

Training should always be considered the training of an individual, planned to meet his needs and develop his potentialities toward the desired objective of a skilled mechanic.

Signal maintenance work covers such a broad field with such numerous specializations that the work has been divided into four broad classifications: fire alarm and police system; communication system; traffic signal system; interlocking system.

Signal work consists of:

1. To test for and locate electrical trouble on the circuits under his jurisdiction, and also to test and keep in proper operating conditions the various specialized equipment on these circuits.

2. To make permanent or temporary repairs for restoration of service as quickly as possible with the means at his disposal; and to make an intelligent report of work needed to be done, in addition to what he has already done, to restore equipment to normal operating conditions.

3. When not engaged in clearing circuit disturbances which have occurred, he patrols and inspects the equipment under his supervision, making minor repairs and reporting equipment in need of major repairs.

4. He goes to locations where damage to or by the equipment has, or may occur; takes the necessary precautions to protect life and property, and to restore service as quickly as possible; and makes a complete report of his findings and actions taken.

5. He supervises major installations and circuit rearrangements to insure continuity of operation of existing circuits, and to prevent any interruption thereto.

A few of the varied types of equipment which the four classifications of signal maintenance men must understand and know how to repair and keep in operation are listed:

Fire and Police Signal System.—Overhead and underground wires and cables.
Cable terminals.
Switchboards.
Telegraph and telephone circuits.
Fire alarm and police boxes.
Registers.
Relays.
Sounders.
Repeaters.
Motors.
Generators.
Batteries.
Use of Morse code.
Radio transmission and reception.

Communication System.—Similar to Fire and Police Signal system but more specialized, handling principally telephone and telegraph circuits and equipment.

Traffic Signal System.—Overhead and underground wires and cables.
Stopwatch timing of signal operation.
Motors.
Relays.
Mechanical and magnetic traffic detectors.
Photo-electric circuits and equipment.
Electric time clocks.
Electric traffic controllers.
Interconnection of traffic signals with automatic railroad gate equipment and track circuits.

Interlocking signal system.—Overhead and underground wire and cable.
Various types of circuits.
Electrical, mechanical, hydraulic, pneumatic, and manual equipment of a wide variety for operating gates, signals, switches, and similar equipment.
Telegraph equipment.
Use of the Morse code.
Practical experience is fundamental to attainment as an operator in this field.
Signal system work consists of:

1. Dispatch fire fighting equipment rapidly and efficiently.
2. Cooperate with the fire alarm system maintenance man in the efficient maintenance of the fire alarm circuits and equipment to the end that there will be an absolute minimum of interruption of service or readiness to serve function of this equipment. To accomplish this result, the signal system operator must have been first a qualified and experienced signal system maintenance man in this field.

XII. LIGHT AND POWER SYSTEMS (GENERATION)

Training should always be considered the training of an individual, planned to meet his needs and develop his potentialities toward the desired objective of a skilled mechanic.

A generation and distribution station operator is a journeyman electrical worker who has the necessary theoretical and practical training to perform efficiently the following work:

1. Check all equipment under his jurisdiction when he comes on duty to make sure that subsequent operation of such equipment may be safe.
2. Operate necessary manual and remotely controlled oil-switches and disconnects to accomplish the necessary interconnection or disconnection of lines, busses, generators, motors, exciters, converters, transformers, capacitors, condensers, and other equipment.
3. Accurately record all such operations.
4. Accurately read all meters at proper intervals and record such readings in the proper manner.
5. Promptly and safely carry out all orders from load-dispatchers or other proper authority.
6. Know and obey all safety rules for the protection of life and property.
7. Cooperate intelligently with maintenance men working on the circuits.
8. Perform various regular and emergency duties such as:

replacement of fuses, maintenance of batteries, checking of relays, clearing commutators and slip-rings on rotating equipment.

XIII. LIGHT AND POWER SYSTEMS (DISTRIBUTION)

Training should always be considered the training of an individual, planned to meet his needs and develop his potentialities toward the desired objective of a skilled mechanic.

1. To test for and locate electrical trouble on the circuits under his supervision.

2. To make permanent or temporary repairs for restoration of service as quickly as is consistent with safety and the limited means at his disposal; and to make an intelligent report of work needed to be done, in addition to what he has already done, to restore equipment to normal operating condition.

3. When not engaged in clearing circuit disturbances which have occurred, he also patrols and inspects the equipment under his supervision, making minor repairs and reporting equipment in need of major repairs.

4. He goes to the location where damage to or from the equipment may be imminent, such as fires, washouts, fallen trees, or similar emergencies, and takes the necessary precaution to prevent such damage.

5. He goes to locations where damage to or by the equipment has happened such as: person injured by electrical contact, poles and wires knocked or blown down, manholes or trees on fire; takes the necessary emergency measures to protect life and property, and to restore service if interrupted; and makes a complete report of his findings and actions taken.

6. Full knowledge of air compressor system for Air Blast Breakers and switches.

XIV. REPAIRS AND WINDING

Training should always be considered the training of an individual, planned to meet his needs and develop his potentialities toward the desired objective of a skilled mechanic.

Electrical Repair Shop and Winder Apprentice.—Opportunities to work at and instructions in the following processes should be given, but not necessarily in this sequence.

1. *General Operation.*—Sweep, errands; clean motors; put away tools, materials, etc.; salvage uscable and salable materials; paint motors and windings; assist other workers; dissemble and assemble motors; learn electrical terms, names and users of electrical equipment, tools, and materials; keep soldering equipment in good working order; oil motors and line shafting; learn use of wire gauge and micrometer.

2. *Strip Windings.*—Strip stator and armature windings; observe and record name plate and winding date; clean slots and frames; clean and tin bar wound coils.

3. *Coil Winding.*—Check data on old coils; wind and spread stator and armature coils; tape and sleeve coils; check and test armature and stator coils for size, span, turns size wire, opens, shorts, make coil forms; wind and insulate field coils; learn relation between wire sizes and proper selection of substitute size.

4. *Transformers.*—Punch and cut laminations; clean and stack laminations; cut insulation; wind transformers; tape coils; put on leads; assemble transformers; test transformers for insulation breakdowns; opens, shorts, ratio, insulation resistance, magnetizing current, iron and copper loss; learn construction features and characteristics of series and potential, auto, insulated, single and polyphase, phase changing, spot welder, booster, line voltage regulating transformers.

5. *Repairing Direct Current Machine.*—Locate and repair troubles in fields, armature, bearings, brushholders, commutators; wind armature; rebuild commutators; test armatures for shorts, open and grounded coils, shorted commutator bars; replace brushes, adjust, align, stagger and locate correct brush positions; remedy conditions causing sparking at brushes, racing, reduced speed, sudden reversals, unsoldering of commutator leads; check fields and interpoles for correct polarity and compounding; check for loose armature core, commutator and field poles; measure field and armature currents; check air gaps; band and balance armatures; solder, turn and undercut commutators; check armature shaft centers, inspect oil rings, replace bearings, adjust end play; cut out and replace armature coils; reconnect armature and fields for different operating voltage or speed; correct noise, vibrations and oil leakage; test motors for speed, load, torque; connect generators for proper direction of rotation, compoundings, parallel operations; locate and repair troubles in arc welding generators; equip motors and generators with proper connecting boxes; check armature shaft and keyway; check lubricating; make temporary armature and field repairs.

6. *Repairing Alternating Current Machinces.*—Locate and repair troubles in stator and motor windings; slip rings, brushholders, and bearings of AC machines; test stators for insulation breakdowns, opens, shorts, wrong connection in windings; wind stators and rotors; connect stators and rotors for other voltages and speeds; cut out and replace coils; check windings with nameplate date; test motors for no load and load currents, single phasing and torque; check for loose rotor stator cores, proper alignment of

cores, loose slip rings, end play, shaft size, keyways, loose head bolts, oil rings and lubrication; test squirrel cage rotors for opens, loosec bars, end rings and fans; band and balance rotors; replace slot wedges; make temporary repairs to AC stator and rotor windings.

7. *Repairing AC and DC Starters and Controllers.*—Locate and repair troubles in all types of AC and DC motor starters; repair and rewind holding coils, adjust locking devices, dashpots, and overload devices; change tap connections; locate and repair troubles in slip ring motor starters and control resistance, across-the-line starters, automatic and reversing starters, elevator, crane, hoist, printing press, laundry, face plate and drum type, dynamic braking, regenerative braking, interlocking and sequence type of control.

8. *Switchboards, Instruments, and Meters.*—Connecting, use of, construction and operation of portable and switchboard types of ammeters, voltmeters, wattmeters, watthour meters, ampere hour meters, meggers, ohmmeters, clamping transformers, current and potential transformers, shunts and multipliers, indicating, integrading, and recording; switchboard layout, construction, testing and repair; oil switches and circuit breakers.

9. *Small Motor and Appliance Repairs.*—Locating and repairing troubles in small motors of vacuum cleaners, drills, portable tools, fans, wash machines, refrigerators, etc.; winding stators and rotors of fractional horsepower motors; testing and checking small motors for electrical and mechanical troubles, starting torque, etc.; repair appliances.

10. *Outside Service and Repairs.*—Service and repairs to all types of electrical machinery, wiring, and equipment.

11. Miscellaneous Related Work

11. *Schooling.*—Day school attendance required for eight hours every other week during the school year without loss of pay for first three years of apprenticeship training.

School Subjects:

	Periods per day
a. Electrical Circuits and Diagrams	2
b. Elementary Theory of Electricity	2
c. Fundamental and Applied Mathematics	1
d. Electrical Code	2

Recommendations: Those unable to complete course during day should attend night school.

Credits and Exemptions: An apprentice wishing to be exempted

from attending school must produce evidence of previous equivalent schooling and take an examination consisting of 20 oral and 20 written problems or questions and pass with a grade of 80 per cent. Examinations to be prepared and supervised by the apprenticeship committee.

Licensed Maintenance Electrician.—A licensed maintenance electrician is an electrical worker who has acquired the necessary theoretical and practical knowledge of commercial and industrial electrical applications to enable him to efficiently repair, maintain and operate the following electrical equipment:

1. Lighting circuits and control equipment of incandescent, fluorescent, cold cathode lighting and electrical lighting for advertising purposes.

2. Signal equipment including intercommunicating, detection, safety signals, elevator signal systems and public address systems.

3. Electric motors and their application to pumps, fans, dumbwaiters, elevators and power driven machinery in industry.

Motor and Motor Control Equipment.—Generation, rectification and distribution of electricity for power and light transformers. Switchboard equipment for light and power. The reading and application electrical indicating recording meters.

Use of electrical testing instruments.

Control systems of automatic heating equipment.

Electrical industrial heating and drying processes.

Control system for air conditioning equipment.

Electronic precipitron equipment.

Photoelectric inspection, counting, sorting, and control equipment.

Elevator equipment.

Electric cranes, and other specialized electrical applications depending upon the particular branch of commerce or industry in which the man is employed.

NATIONAL JOINT APPRENTICESHIP AND TRAINING COMMITTEE
FOR THE ELECTRICAL INDUSTRY
(Address)

APPRENTICESHIP AGREEMENT

THIS AGREEMENT, entered into this.....day of....., 19...., between the parties to.....
Name of Electrical Apprenticeship Standards
represented by the Joint Apprenticeship Committee, hereinafter referred to as the COMMITTEE and....., hereinafter referred to as the
Name of Apprentice
APPRENTICE (and if a minor).....
Name of Parent (or Guardian)
hereinafter referred to as his Guardian.

WITNESSETH THAT:

WHEREAS, in order to preserve and perpetuate the skills essential to true craftsmanship and to maintain the ranks of skilled mechanics in the electrical industry; and

WHEREAS, the above named Electrical Apprenticeship Standards have been developed in conformity with the National Electrical Apprenticeship Standards which have been registered with the Federal Committee on Apprenticeship, Apprentice-Training Service; and

WHEREAS, the APPRENTICE through his parent (or Guardian) has expressed a desire to enter the required period of apprenticeship subject to the aforementioned Standards,

NOW, THEREFORE, in consideration of the premises and the mutual covenants herein contained the parties hereto do hereby agree as follows:

THAT, the Committee shall provide employment and training to the APPRENTICE in accordance with the Standards herein referred to

THAT, the APPRENTICE shall perform diligently and faithfully the work of said trade during the period of apprenticeship, in conformity with the aforementioned Standards and in accordance with the rules and regulations of the said Joint Apprenticeship Committee.

THAT, the GUARDIAN will make all reasonable efforts to assure proper and diligent performance by the APPRENTICE of all obligations assumed under this agreement.

The Electrical Standards referred to herein is hereby incorporated in and made a part of this agreement.

In witness whereof the parties hereunto set their hands and seals:

.....(SEAL)	.....(SEAL)
Apprentice	Representative of Joint Apprenticeship Committee
.....	.....
Address	Title
.....(SEAL)	.....(SEAL)
Parent (or Guardian)	Representative of Joint Apprenticeship Committee
	.....
	Title

Registered by the.....
by....., Title ..... Date ....., 19....

The undersigned agrees to provide employment and training in accordance with Standards named herein.

1st	2nd .....
Employer	Employer
3rd	4th .....
Employer	Employer

Certificate of Completion of Apprenticeship

NATIONAL JOINT APPRENTICESHIP AND TRAINING COMMITTEE FOR THE ELECTRICAL INDUSTRY

By this certificate declares that _____ *is qualified as a Journeyman by having served his apprenticeship according to the National Apprenticeship and Training Standards for the Electrical Industry approved by the National Electrical Contractors Association and the International Brotherhood of Electrical Workers in cooperation with the Federal Committee on Apprenticeship.*

Done this _____ *day of* _____ *19*__

(Name of Club)
Joint Apprenticeship and Training Committee

National Joint Apprenticeship and Training Committee for the Electrical Industry

_____ *Chairman*

_____ *Secretary*

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION

633 INVESTMENT BUILDING, WASHINGTON 5, D. C.

TELEPHONE — REPUBLIC 7308

February 20, 1945

TO ALL ELECTRICAL CONTRACTORS AND LOCAL ASSOCIATIONS
IN THE ELECTRICAL CONSTRUCTION INDUSTRY:

The National Electrical Contractors Association, at its 43rd Annual Meeting held at French Lick, Indiana, on October 5, 1944, gave unanimous approval to the revision of the National Apprenticeship & Training Standards, originally introduced in October, 1941, through the cooperative efforts of the National Joint Apprenticeship Committee for the Electrical Industry, composed of representatives of the International Brotherhood of Electrical Workers and this Association, with the assistance of the Federal Apprentice Training Service.

The rapid growth of the electrical industry and the advancement of its technical demands upon craftsmanship, require constant review of established standards. The National Joint Apprenticeship & Training Committee was assigned the responsibility of revising the original National Apprenticeship Standards to extend their scope to cover all branches of electrical work. The revised Standards published in this bulletin are the result of the complete cooperation and harmony between employers and labor which have prevailed throughout this undertaking.

Our responsibility as electrical contractors is to insure for our industry an adequate supply of competent craftsmen to serve the public's needs. A productive apprenticeship and training program that will bring in a constant flow of thoroughly trained electrical workers is vital to our industry; every electrical contractor, therefore, is obliged to soonsor and support such a program in his locality.

We strongly recommend all local associations to cooperate with local organizations of electrical workers in establishing an apprenticeship and training system for the electrical industry in their particular locality. These National Apprenticeship & Training Standards outline suggested methods and procedures, and are a framework within which the local apprenticeship and training program may be built.

The National Electrical Contractors Association urges immediate action on the part of everyone concerned in developing a sound national apprenticeship and training system in the electrical industry, and stands ready to offer all possible assistance in the achievement of this objective.

Yours very truly,

Robt. W. McChesney

Robt. W. McChesney, President

E. H. Herzberg

E. H. Herzberg, Chairman
NECA Apprenticeship Committee.

International Brotherhood Electrical Workers

1200 Fifteenth Street N. W.
Washington 5, D. C.

April 16, 1945

Apprentice-Training Service
War Manpower Commission
Washington 25, D. C.

Gentlemen:

The International Brotherhood of Electrical Workers gave wholehearted approval on October 14, 1941, of the National Electrical Apprenticeship Standards developed by the National Joint Apprenticeship Committee for the Electrical Construction Industry.

We felt it was essential that the employer and labor organization be in agreement concerning the standards and rules of employment and training if the level of apprentice training was to be uniformly raised throughout the nation.

Our successful experience demonstrated the need to establish apprenticeship standards applicable to all the highly skilled branches of the electrical industry, therefore, our National Joint Apprenticeship and Training Committee was given responsibility to revise the National Standards.

The Brotherhood is anxious to expand its apprenticeship program, consistent with the standards expressed in this document, to all affiliated local organizations, and is prepared to give all possible assistance in helping to organize and maintain local apprentice training programs.

The assistance and cooperation of representatives of the Apprentice-Training Service of the War Manpower Commission in the preparation and publication of this document is greatly appreciated. The ATS representatives in the field are prepared to assist respective local organizations with their apprentice training problems. We have requested that they make themselves known at the earliest possible time.

Respectfully yours,

Ed J. Brown

Ed J. Brown
International President

G. M. Bugniazet

G. M. Bugniazet
International Secretary

STATE APPRENTICESHIP AGENCIES

(Including Names of Full-time Directors)

Arizona Apprenticeship Council*
Department of Labor
Phoenix, Ariz.

Arkansas Apprenticeship Council*
Department of Labor
Little Rock, Ark.

Archie J. Mooney, Secretary
California Apprenticeship Council*
Department of Industrial Relations
San Francisco, Cal.

Connecticut Apprenticeship Council
Department of Labor
Hartford, Conn.

Florida Apprenticeship Council
State Industrial Commission
Tallahassee, Fla.

Eugene H. Jordan
Director of Apprenticeship
Hawaii Apprenticeship Council*
Department of Labor and Industrial Relations
Honolulu, T. H.

Iowa Apprenticeship Council
Bureau of Labor
Des Moines, Iowa

Kansas Apprenticeship Council
Labor Department
Topeka, Kan.

Kentucky Apprenticeship Council*
Department of Industrial Relations
Frankfort, Ky.

Louisiana Apprenticeship Council*
Department of Labor
Baton Rouge, La.

Maine Apprenticeship Council*
Department of Labor and Industry
Augusta, Maine.

Massachusetts Apprenticeship Council*
Department of Labor and Industries
Boston Mass.

Frank Musala
Director of Apprenticeship
Minnesota Apprenticeship Council*
St. Paul, Minn.

Montana Apprenticeship Council*
Division of Labor
Helena Mont.

Nevada Apprenticeship Council*
Department of Labor
Carson City, Nev.

New Hampshire Apprenticeship Council
Bureau of Manufacturing
Manchester, N. H.

New Mexico Apprenticeship Council
Labor and Industrial Commission
Albuquerque, N. M.

John J. Sandler
Director of Apprentice Training
New York State Apprenticeship Council*
New York Department of Labor
Albany, N. Y.

Clarence Beddingfield
Director of Apprenticeship
North Carolina Apprenticeship Council*
Department of Labor
Raleigh, N. C.

Ohio Apprenticeship Council
Department of Industrial Relations
Columbus, Ohio

Lorrin H. Andrews
Director of Apprenticeship
Oregon Apprenticeship Council*
Department of Labor
Portland, Ore.

Pennsylvania Apprenticeship Council
Department of Labor and Industry
Harrisburg, Penn.

Rhode Island Apprenticeship Council
Department of Labor
Providence, R. I.

Vermont Apprenticeship Council
Department of Industrial Relations
Montpelier, Vt.

Robert H. Wilson
Director of Apprenticeship
Virginia Apprenticeship Council*
Department of Labor and Industry
Richmond, Va.

Washington Apprenticeship Council*
Department of Labor and Industry
Seattle, Wash.

Walter F. Simon
Supervisor of Apprenticeship
Wisconsin Industrial Commission*
Madison, Wisc.

* State apprenticeship law enacted.

REGIONAL OFFICES

APPRENTICE TRAINING SERVICE
WAR MANPOWER COMMISSION

For information regarding the services of field representatives of the Apprentice-Training Service in the establishment of apprenticeship systems and other types of in-plant training programs, communicate with the representative at the nearest regional office listed below:

Region I (Maine, N. H., Vt., Mass., R. I., Conn.)	Joseph E. Johnson, Supervisor Room 744, 55 Tremont St. Boston 8, Mass.
Region II (New York State)	John M. Marion, Supervisor Room 617, Old New York State Bldg. New York 16, N. Y.
Region III (Pa., N. J., Del.)	Glenn H. Feller, Supervisor 811-812 Stephen Girard Bldg. Philadelphia, Pa.
Region IV (Md., Va., W. Va., N. C., D. C.)	Robert F. Handley, Supervisor Room 207, 433 Third St., N. W. Washington 25, D. C.
Region V (Ohio, Mich., Ky.)	John E. Morley, Supervisor Room 674, Union Commerce Bldg. Cleveland 14, Ohio
Region VI (Ill., Ind., Wis.)	Edward C. Madsen, Supervisor 222 W. Adams Street Chicago, Ill.
Region VII (S. C., Ga., Tenn., Miss., Fla., Ala.)	J. M. Parmelee, Supervisor 622 Grand Theatre Bldg. Atlanta 3, Ga.
Region VIII (N. Dak., S. Dak., Nebr., Iowa, Minn.)	John F. Barrett, Supervisor Room 500, Midland Bank Bldg. Minneapolis, Minn.
Region IX (Mo., Kans., Ark., Okla.)	Taylor F. Custer, Supervisor Room 1600, Fidelity Bldg. Kansas City, Mo.
Region X (La., Tex., N. Mex.)	Travis J. Lewis, Supervisor 6th Floor, Mercantile Bank Bldg. Dallas, Tex.
Region XI (Mont., Idaho, Utah, Wyo., Colo.)	Ray A. Gross, Supervisor Room 614, Security Life Bldg. Denver, Colo.
Region XII (Oreg., Wash., Ariz., Nev., Calif.)	Broncel R. Mathis, Supervisor Room 701, Western Furniture Exchange and Merchandise Mart San Francisco, Calif.

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STATE APPRENTICESHIP AGENCIES

(Including Names of Full-time Directors)

Arizona Apprenticeship Council*
Department of Labor
Phoenix, Ariz.

Arkansas Apprenticeship Council*
Department of Labor
Little Rock, Ark.

Archie J. Mooney, Secretary
California Apprenticeship Council*
Department of Industrial Relations
San Francisco, Cal.

Connecticut Apprenticeship Council
Department of Labor
Hartford, Conn.

Florida Apprenticeship Council
State Industrial Commission
Tallahassee, Fla.

Eugene H. Jordan
Director of Apprenticeship
Hawaii Apprenticeship Council*
Department of Labor and Industrial Relations
Honolulu, T. H.

Iowa Apprenticeship Council
Bureau of Labor
Des Moines, Iowa

Kansas Apprenticeship Council
Labor Department
Topeka, Kan.

Kentucky Apprenticeship Council*
Department of Industrial Relations
Frankfort, Ky.

Louisiana Apprenticeship Council*
Department of Labor
Baton Rouge, La.

Maine Apprenticeship Council*
Department of Labor and Industry
Augusta, Maine.

Massachusetts Apprenticeship Council*
Department of Labor and Industries
Boston, Mass.

Frank Musala
Director of Apprenticeship
Minnesota Apprenticeship Council*
St. Paul, Minn.

Montana Apprenticeship Council*
Division of Labor
Helena, Mont.

Nevada Apprenticeship Council*
Department of Labor
Carson City, Nev.

New Hampshire Apprenticeship Council
Bureau of Manufacturing
Manchester, N. H.

New Mexico Apprenticeship Council
Labor and Industrial Commission
Albuquerque, N. M.

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New York State Apprenticeship Council*
New York Department of Labor
Albany, N. Y.

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Providence, R. I.

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OTHER ATS PUBLICATIONS AVAILABLE

Copies of any of the following publications may be obtained by writing to the ATS representative at the nearest regional office listed on the inside back cover of this pamphlet, or to Apprentice-Training Service, Bureau of Training, War Manpower Commission, Washington 25, D. C.

THE NATIONAL APPRENTICESHIP PROGRAM: Review of development of apprenticeship in ths country and how apprenticeship systems are established. Explanation of functions of Apprentice-Training Service, Federal Committee on Apprenticeship. State apprenticeship agencies, National, State and local apprenticeship committees, and of procedure with respect to apprenticeship agreements and selection of applicants for apprentice training. Also included is a list of apprenticeable trades.

APPRENTICE TRAINING FOR VETERANS: A brief, simple explanation of what apprentice training is, career opportunities it offers, qualifications required, benefits of the G. I. Bill and Public 16, and where to apply for apprentice training. Included in the contents is a list of approximately 100 skilled trades in which workers are given apprentice training. Also listed are the ATS publications available, the regional offices of Apprentice-Training Service, and the State apprenticeship agencies.

LOOKING AHEAD BY WAY OF APPRENTICESHIP: A simply expressed explanation of apprentice training and its advantages to young men in equipping them for careers as craftsmen in the skilled trades. Also explains the functions of joint management-labor apprenticeship committees, in setting up and administering apprenticeship programs, as well as the service rendered by Apprentice-Training Service and State apprenticeship agencies in assisting industry in establishing these programs.

NATIONAL STANDARDS

NATIONAL STANDARDS FOR CARPENTRY APPRENTICESHIP, Bulletin No. 54.

BUILDING A NATIONAL PAINTING AND DECORATING APPRENTICESHIP SYSTEM, Bulletin No. 23: A manual of procedure for establishing local painting and decorating apprenticeship standards.

PUTTING NATIONAL PLUMBING APPRENTICESHIP STANDARDS TO WORK, Bulletin No. 16: A manual of procedure for establishing local plumbing apprenticeship standards.

NATIONAL STANDARDS FOR STEAM FITTING APPRENTICESHIP, Part I, Bulletin No. 28: Includes suggestions for putting national standards into operation in local communities.

SUGGESTED LOCAL STANDARDS FOR TRAINING STEAM FITTING APPRENTICES, Part II, Bulletin No. 28: Based on The National Standards for Steam Fitting Apprentices.

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